Chandra X-ray Center

CIAO

Jonathan McDowell

I will report on CIAO (user software) and the standard processing pipeline software, which come into being thanks to:

CXC Data Systems team:

software design, development. operations/archive, etc.

CXC Science Data Systems team:

requirements, documentation, testing, helpdesk,
interface with science community

Your SDS Contacts

Chandra X-ray Center

Current team:

SAO Scientists

Jonathan McDowell	SDS lead, data model, coords
Antonella Fruscione (½ time)	SDS-SAO dep.lead, Docs and Release lead
Aneta Siemiginowska	Catalog, Sherpa, Astrostatistics
Doug Burke	Catalog, Scripts, Infrastructure, Sherpa/ChIPS, Releases
Frank Primini	Catalog, Photometry, Source Detection, HRC

SAO IT Specialists

Kenny Glotfelty	Helpdesk, scripts, docs, legacy expertise
Nick Lee	Helpdesk, scripts, docs
Bill Joye	DS9

MIT Scientists (~3.5FTE)

Mike Nowak	SDS-MIT lead, Catalog, timing, responses
Dave Huenemorder	Gratings, responses
Glenn Allen	ACIS (e.g. acis_process_events)
Moritz Guenther	MARX

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Community Support: Downloads, Documentation, Helpdesk

CIAO 4.7, 4.8 Downloads

CIAO 4.8 is the current supported release.

Downloads of CIAO 4.7 (released 2014 Dec 16)
and CIAO 4.8 (released 2015 Dec)

	CIAO 4.7 (Sep 2015-Aug 2016)	CIAO 4.8 (Dec – Aug)
Linux	420 (of which 84 were 32-bit)	592
Mac	189 (19 older)	594 (314 ElCap)
Source build	55	60
Total	664	1246

Summary:

- Total CIAO demand still strong (6% increase compared to same time last year)
- Mac demand has increased to 50%
- 46 downloads of CIAO4.7 32-bit linux since CIAO4.8 release (dropped 32-bit support)

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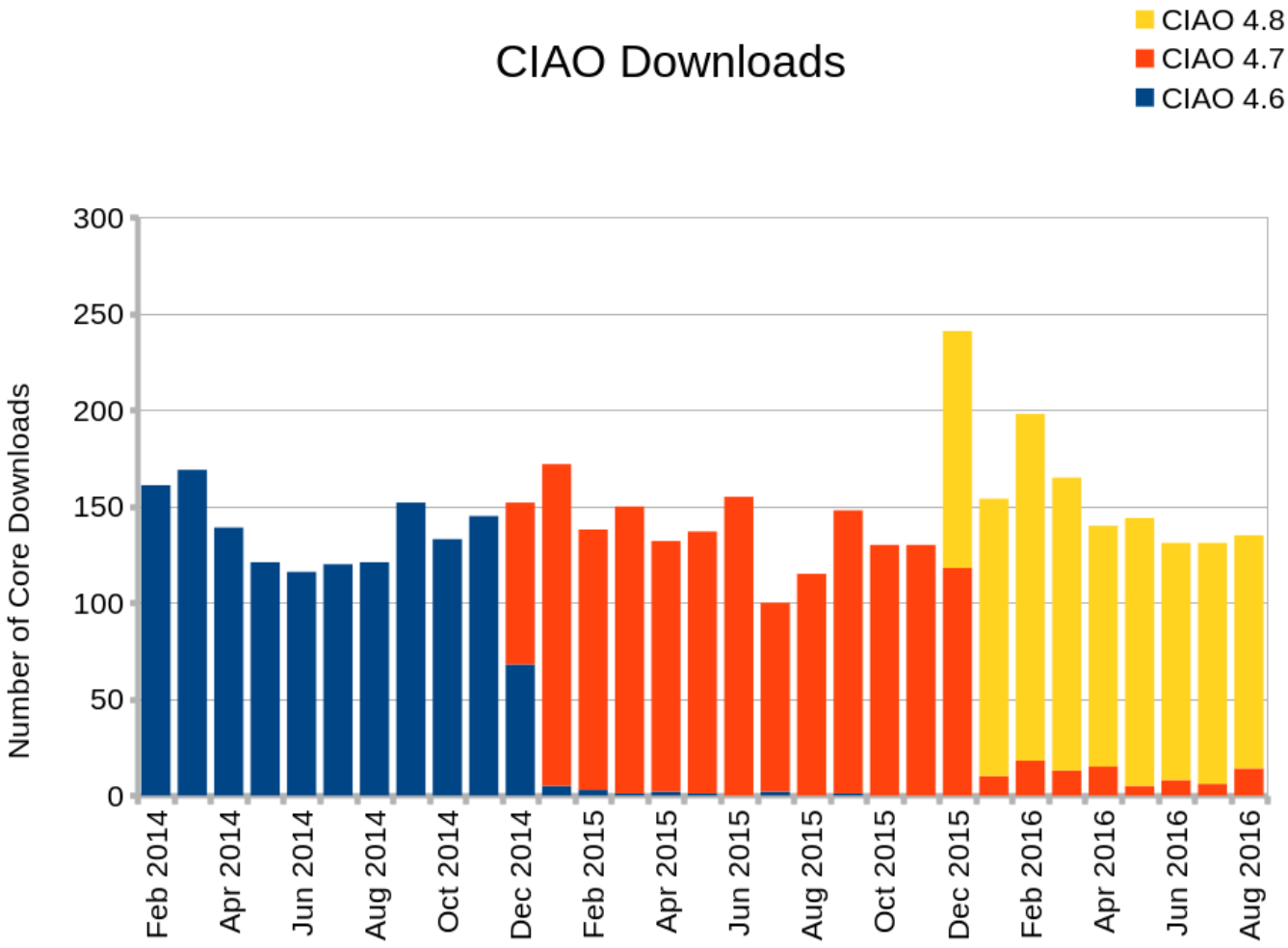

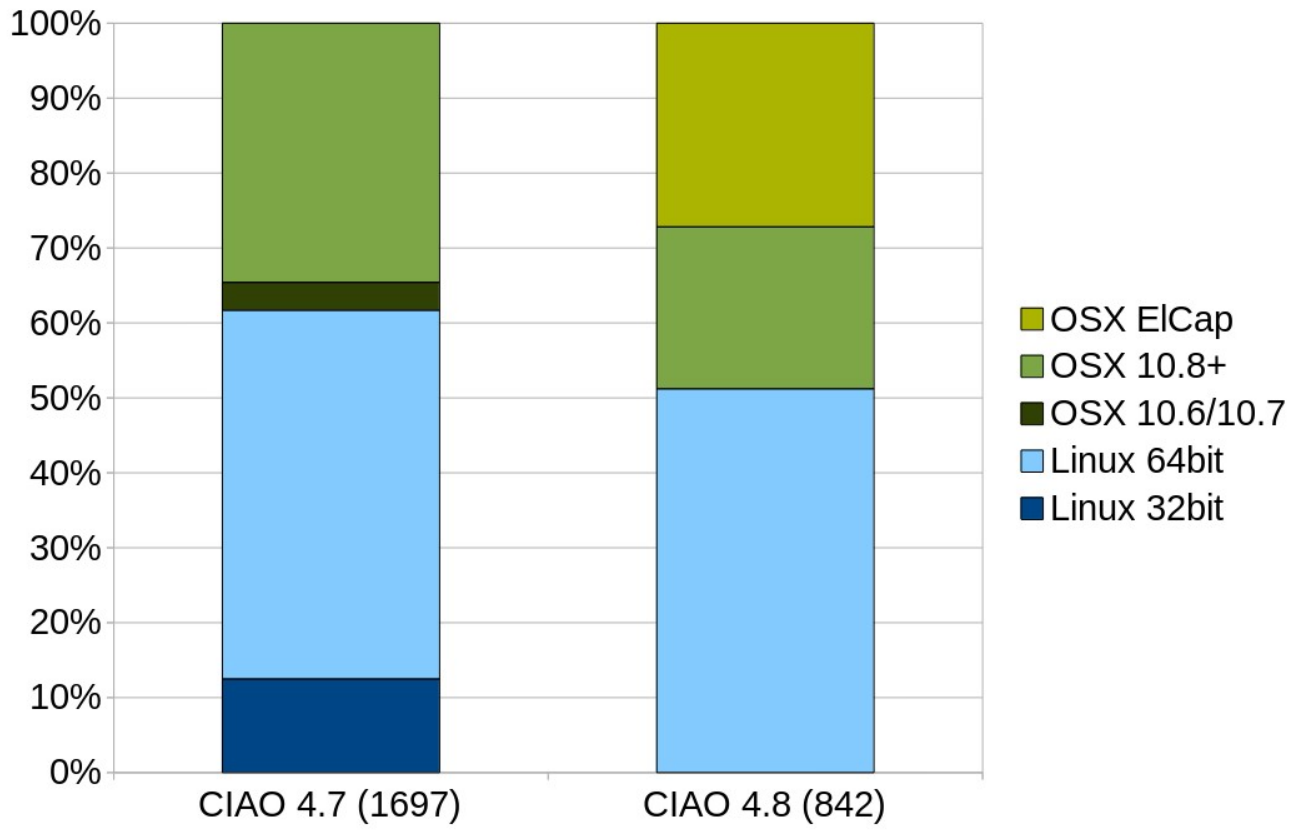

OS breakdown, CIAO4.8 (last 9 months) compared to 4.7 (since Dec 2014)

New Doc Items

Why Topic: Pitfalls using PIMMS for Observed Data
http://cxc.harvard.edu/ciao/why/pimms.html

FAQ entry: What does "zero length polygon line segment" warning mean?
http://cxc.cfa.harvard.edu/ciao/faq/polygon_zero_warning.html

Thread: HETG/ACIS CC-mode Grating Spectra
http://cxc.harvard.edu/ciao4.8/threads/spectra_hetg_acis_cc

Updated Threads for CIAO4.8

- Reprocessing threads (for CC mode upgrade)
- Fine Astrometric Corrections (for reproject_aspect/wcs_update changes)
- Phase bin thread (remove no-longer-needed workaround)
- PSF threads (include use of install_marx script)

General updates

- New navbar designed for CIAO 4.8
- Routine site migration updates for CIAO 4.8
- Improvements to PSF Central pages
- New quick start guide

Web site analytics

- Most users reach pages via Google search
- Threads and ahelp files are the most-visited pages
- Our web site is divided structurally into CIAO, Sherpa, ChiPS
- ChaRT site absorbed into CIAO pages

	CIAO	Sherpa	Chips	
Sessions	71863	17694	3160	
Users	23988	7816	1941	
Pageviews	225686	48563	7726	
Duration	5:25	4:12	2:54	(min:s)

Improved main download page:

- Simplified prominent 'standard install' button
- Important warnings at top
- Custom options now on separate page

CIAO

- Introduction
- **Download CIAO**
- Data Analysis
- Documentation
- Sherpa (Modeling and Fitting)
- ChIPS (Plotting Package)
- Scripting in CIAO
- Data Products
- PSF Central NEW
- Workshops
- CXC Links
- CXC HelpDesk
- Site Map

CIAO on social media

Downloading CIAO 4.8.1/4.8.2

WHAT'S NEW | WATCH OUT

32bit Linux and OSX 10.6.8/10.7: End of Life

CIAO is no longer available for 32bit Linux nor for OSX 10.6.8 & 10.7. CIAO 4.7 is still available for users who are unable to upgrade their system. The platform support page describes the operating systems that can be used with CIAO 4.8.1.

CIAO 4.8.2

CIAO 4.8.2 is only distributed for Mac OS X 64-bit 10.11 (El Capitan).

The CIAO 4.8.2 patch is identical to the CIAO 4.8.1 patch, with a fix on a bug introduced by the previous patch that only affects the OS X 10.11 (El Capitan) pre-compiled binaries.

Functionally, CIAO 4.8.1 and 4.8.2 are the same across platforms.

Steps to install CIAO (if the following does not work then try the Manually Installing CIAO 4.8.1/4.8.2 thread):

1

Download the `ciao-install` installation script:

Standard Install with the base CALDB or Jump to the custom installation

What is the download called?

The following document assumes that the script has been downloaded with the name `ciao-install`. This is the default name, but the web browser may well add on a suffix (such as "`(1)`") to avoid overwriting an existing file. Please rename the downloaded file - or use the new name - in the following steps!

2

Run the script that has been downloaded; this will download the requested parts of CIAO and install them on your system, and is described in more detail in the Installing CIAO 4.8.1/4.8.2 using the ciao-install script thread:

```
unix% bash /<path>/ciao-install
```

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New separate custom download page:

CIAO

- Introduction
- **Download CIAO**
- Data Analysis
- Documentation
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- ChIPS (Plotting Package)
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- PSF Central NEW
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CIAO on social media

Custom Installation: CIAO 4.8.1/4.8.2 & CALDB 4.7.1

WHAT'S NEW | WATCH OUT

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This page allows users to create a customized version of the `ciao-install` installation script: that is, select exactly which packages are installed and whether the source code is also downloaded. The inital options are those used by the Standard Install with the base CALDB version.. If the following does not work then try the Manually Installing CIAO 4.8.1/4.8.2 thread.

1

Clear options

Platform: Autodetect Platform

The default setting - "Autodetect Platform" - allows ciao-install to determine what platform you are using and to select the appropriate build of CIAO. The Platform Support page has more information on the officially supported CIAO platforms.

- ☑ CIAO analysis tools - v2/v3
  - CIAO analysis tools v2 and v3 are functionally identical, except v3 fixes a bug affecting OSX 10.11 El Capitan.
- ☑ Sherpa modeling and fitting package - v1
  - Sherpa is also available directly from GitHub, if you wish to install it outside of CIAO or help its development, by adding new features, reporting or fixing bugs, or adding documentation.
- ☑ Chips plotting package - v1
- ☑ Prism file-browsing GUI - v1
- ☑ ObsVis observation visualizer for proposal planning - v1
- ☑ Scripts Package - version 2
- ☑ Base CALDB v4.7.1
  - The CALDB contains all the calibration files required for Chandra data analysis. The `ciao-install` script will determine whether a patch file can be installed, or if a full download is required.
- ☐ CALDB: ACIS background event files v4.6.9
  - The ACIS background files - derived from observations - are large, and so not included in the base CALDB.

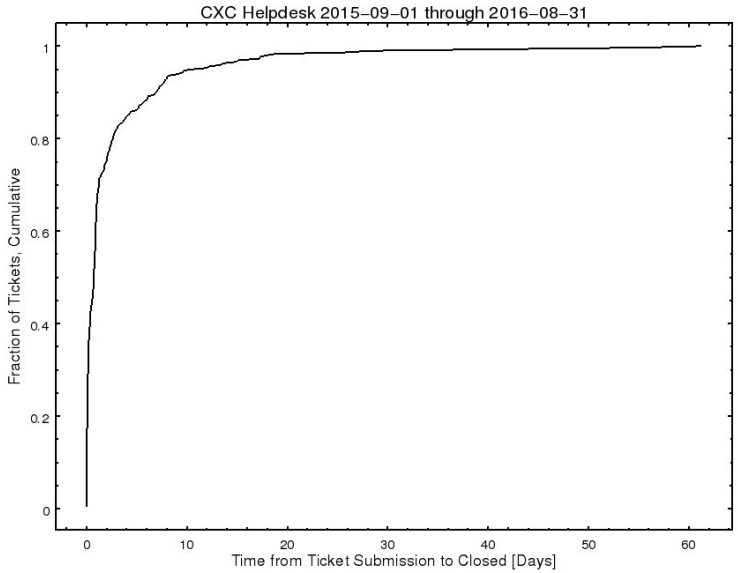
Community Support

- Helpdesk: 307 new tickets (Sep 1 2015 –Aug 31 2016)
  - compare 278 tickets for same period last year

  » Median time to first ticket answer 3.5 hour
  – Median time to final answer 17 hr

  » Bugs found: see next slide
  » Documentation improved: aspect-blur why topic; group net counts; plot of data outside noticed range (why topic)

  – 87% of tickets did not require scientist or DS support



Community Support – Helpdesk system

- CXC transitioned to a new helpdesk system May 23 2016 ("osTicket")
- Wonderdesk no longer supported; osTicket is free and has active support
- Better attachments; supports HTML replies, improved features
- Handles both proposal (CDO) and analysis (SDS) questions
- SDS took over responsibility for assigning tickets from CDO

Bugs from helpdesk tickets

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- This year users did find some noteworthy bugs for us:
  - blank-sky files failing in acis_process_events (no TIME column)
    - this was an undesired result of a change in 4.8
  - crates memory leak (found in sherpa fake/save case)
  - wcs_update wasn't updating quaternions
    - shows up in ChaRT, which we patched to recompute them
  - Corner case issues: dmmerge special case: EQPOS filter caused subspace issue; a_p_e handling of invalid chip coords; merge_obs issue with interleaved mode data; specextract issue with 1999 data
  - Major issue: acis_process_events failed on certain long observations
    - triggered 4.8.1 and 4.8.2 patches

CIAO Testing

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For CIAO 4.8, we discovered some regression failures late in the release cycle that we should have spotted earlier.

Performed high level review of our test suite and infrastructure.

New high level driver scripts run tests in parallel, provide feedback on individual tests during the regression run (don't need to wait for run to complete)

Updated several tests to reduce false negatives

- version string mismatches, order of running tests, etc.

Updated selected tests to remove duplication, use smaller files in example tests etc.

Reduced SDS regression test run time from 18 hours to 4 hours

Increased confidence in process

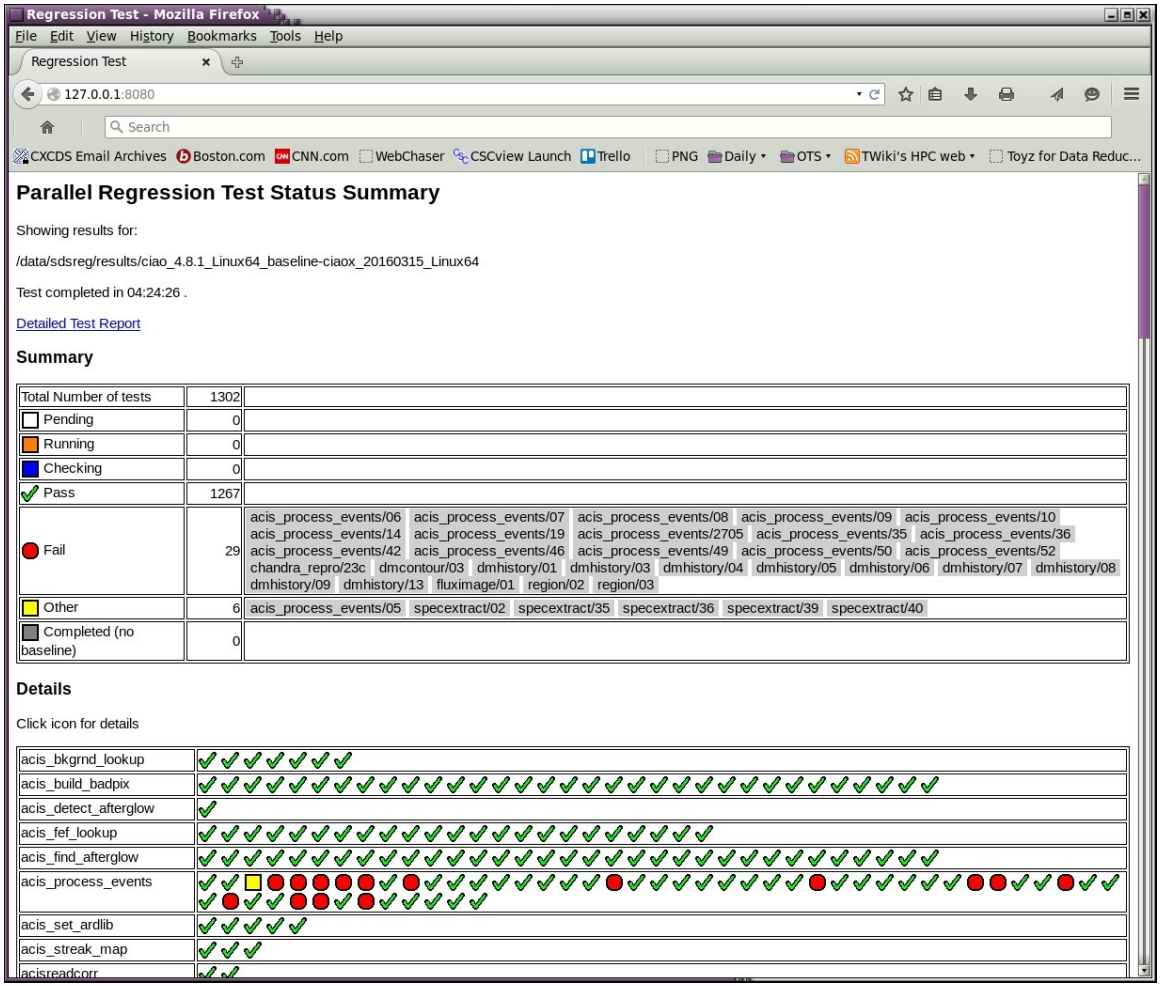
Now running tests on weekly CIAO builds and giving feedback to DS developer teams

Review of the 1300 individual test scripts will continue on a time-available basis to see what can be made more robust, or what can be simplified

Evaluating adding contrib scripts (e.g. chandra_repro) to CIAO download smoke tests. This would require a nontrivial increase in accompanying data size.

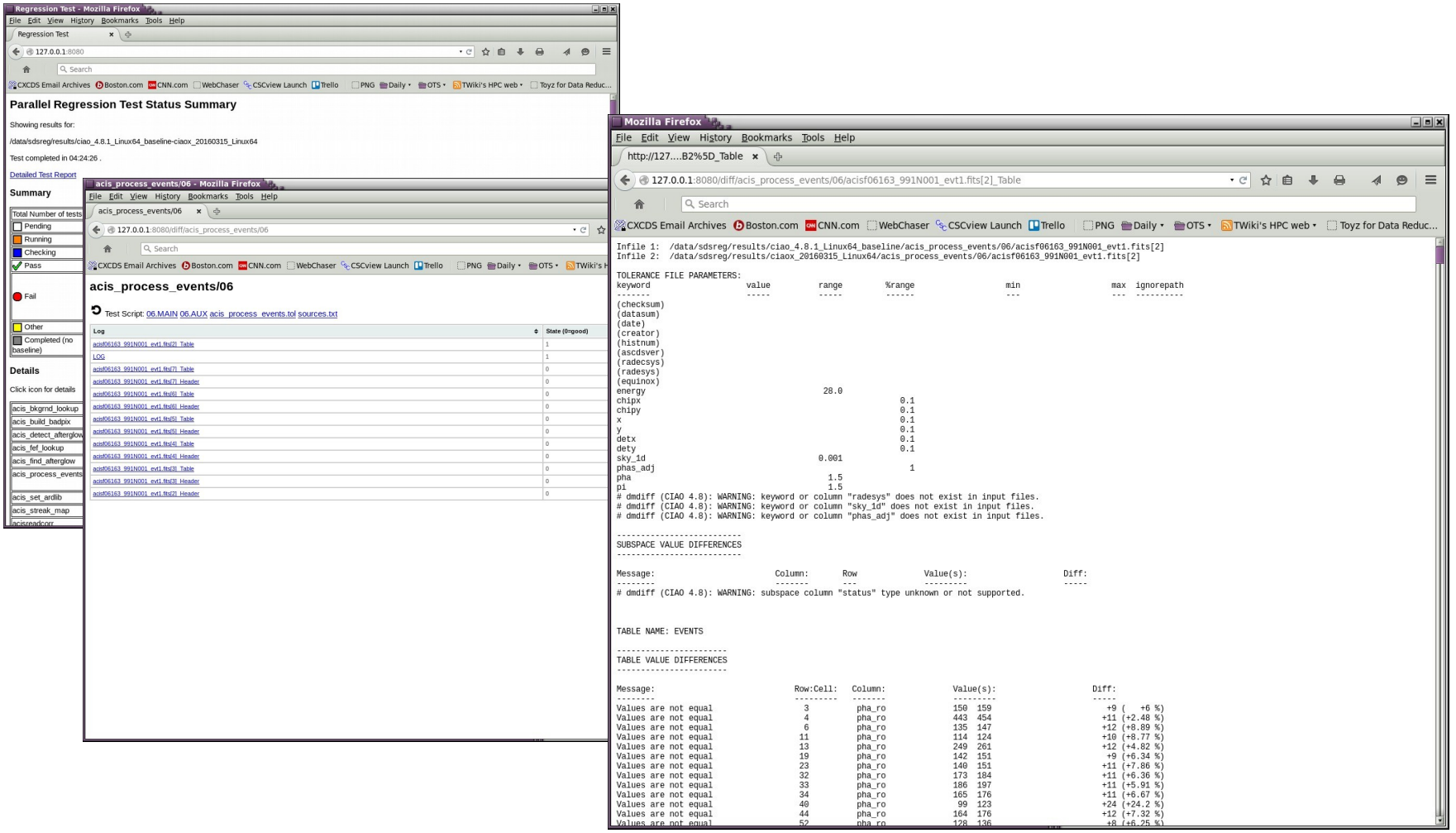
CIAO Testing

New regression test summary shows multiple failures in acis_process_events test



CIAO Testing

Clicking down through individual tests shows that pha_ro variable has discrepant values
In this case, differences are expected due to change in algorithm – need to update regression save data



Community support: AAS booth

Florida Jan 2016:
SDS, DS, CDO staff
and… users?

Organized 'Lectures in Astrostatistics' session – full room of attendees

12th CIAO Workshop at the Chandra Next Decade meeting

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A 1.5-day CIAO workshop was held on Mon-Tues, 15-16 Aug 2016 at CFA before the Chandra Next Decade meeting.

17 students [grad students, postdocs, faculty/staff] attended for hands-on CIAO training. Students were from around the world.

Science Organizing Committee:
Antonella Fruscione + Kenny Glotfelty SDS

Talks: Intro to X-ray,
Chandra PSF,
DS9 and DAX

Hands-on sessions: SDS/DS team gave one-on-one support throughout the day

'X-ray Data Analysis in the Next Decade' panel at the Chandra Next Decade meeting

A lunchtime panel was held during the meeting to discuss future analysis challenges

We invited Koji Mukai, Nico Capelluti, Ewan O'Sullivan, Rafaella Margutti, and Joey Nielsen to give their thoughts on hardware, software and algorithm challenges for the next decade. We also solicited comments from the audience. The session was well attended and the discussion was productive.

Some points that came up repeatedly:

- Lots of demand for CIAO compatibility with astropy (we had a 'Google Summer Of Code' intern do some work on this over the summer)

- Demand for parallel processing, particularly for tools like dmcopy

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Technology

Parallelization (especially core tools); process many sources at once

Make it easy to include user code & astropy in CIAO/sherpa

Use conda for distro?

Web tools (JS9, etc.) are useful for undergrad teaching (but beware security issues)

Support for data sharing and collaboration tools

Science algorithms

Multi-observation spectral analysis – source detect. PSF issues, extended sources

Multi-resolution analysis: simultaneous fitting of high and low resolution data

(spatial, spectral); joint analysis of NuStar/Chandra etc.;

source detection with HST prior

Easy scripts for grating analysis

Continue deployment of advanced statistical tools with interfaces for general users

- including event-based fitting approaches?

Easy generation of PSFs

Beyond Chandra (in scope or not?)

General multiwavelength data analysis

Sensitivity calculations across different surveys

Some additional, existing CIAO future priorities

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Technology

Keeping up with the FITS standard (64 bit integers, etc)

Evolve system for simpler post-mission maintenance

Spacecraft changes

Periscope drift, HRC 'tailgating', off-axis angle drift

Science algorithms

- Extended source support:
  - Smoothing, temperature maps
  - Multi-obsid source flux
  - Multi-obsid detect, leveraging CSC release 2
  - Continued improvements to PSF generation & characterization
  - Improved PSF+extended source fitting in Sherpa
- Bayesian methods
  - Interfaces to let non-experts use MCMC etc

Beyond Chandra

Multiwavelength support: better CIAO support for general WCS (esp. rotations)

CIAO Community Support – Social Media

Social Media

- Facebook page
- Twitter stream @chandraCIAO
- Google+ page

Managed in an integrated way (same message can be sent automatically to all the streams)

Twitter now widely used by astronomers and is a useful channel
to rapidly draw users' attention to new capabilities or to bugs

CALDB Releases

- SDS supports all CALDB releases:
  - test the downloading of the files
  - test that the files work with CIAO tools
  - Update threads, add new threads, add “Why” documents etc as needed to reflect changes in calibration data and in methods of applying them
  - Add a section in the release notes “How CALDB x.x Affects Your Analysis”
    - Crucial extra help for users: do **my** data need to be reprocessed because of a given calibration change? How **much** is the change for a typical user?

- In the reporting period: CALDB 4.6.9 to 4.7.2
  - New TGAIN
  - Support for CC mode pipeline changes

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CIAO 4.8/4.9 and Scripts Overview

CIAO Release

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- This year, top priority continues to be Catalog Release 2 support

- CIAO 4.8:

  Maintenance release, released as planned Dec 2015

  - CC mode improvements completed
  - New scripts but no major development except in areas related to source catalog
  - Script releases

- CIAO 4.9
  - Scheduled for Dec 2016 release
  - Maintenance and bugfixes
  - Beta1 internal drop tested by SDS in Jun-Jul
  - Beta support for Python3

SDS Scripts

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Releases

- 4.7.4 Sep 2015 (previewed at last CUC): readout_bkg, install_marx, download_obsid_caldb
- 4.8.1 Dec 2015 with CIAO4.8 - removed deprecated scripts superseded by combine_grating_spectra; updated scripts to match CIAO4.8
- 4.8.2 Jan 2016 Added parameter for random seed to merge_obs/fluximage scripts and to readout_bkg (allows control for reproducible values in regression tests)

  Updated convert_xspec_user_model to work with Sherpa changes and support XSPEC initialization strings

  Added sherpa.contrib.utils.renorm to guess normalization of model components (developed during R&D for Catalog)
- 4.8.3 Apr 2016 New simulate_psf script (see later in presentation)

  Updated install_marx to support new version; improved specextract handling of blank sky files
- 4.8.4 Oct 2016 planned:

  blanksky - create background event list tuned to observation using blank sky files

  blanksky_image - make correctly scaled background image from output of above

  Other items in development being considered for release

SDS Contributed Scripts

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Script release 4.8.1 – released Dec 15 with CIAO 4.8

Updates to support tool parameter file changes and changes in Sherpa

No new functionality

Script release 4.8.2 – released Jan 27

Updated scripts

- *fluximage, merge_obs, flux_obs, reproject_obs, readout_bkg*:
  Added "random" seed parameter (can control reproducibility for regression testing)
- *convert_xspec_user_model* - add suport for XSPEC model initialization strings
- *sherpa_contrib.utils.renorm* - easy way to get rough normalization guesses for model, developed for Catalog project
- *sherpa_contrib.chart* now supports the new ChaRT
- *sherpa_contrib.utils.estimate_weighted_expmap* - fix to make compatible with CIAO4.8

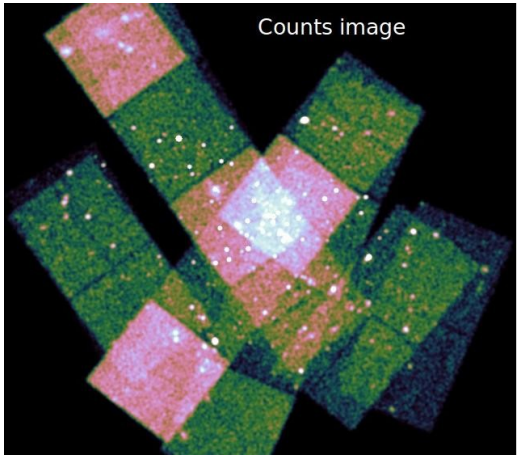
Script release 4.8.3 – released Apr 13

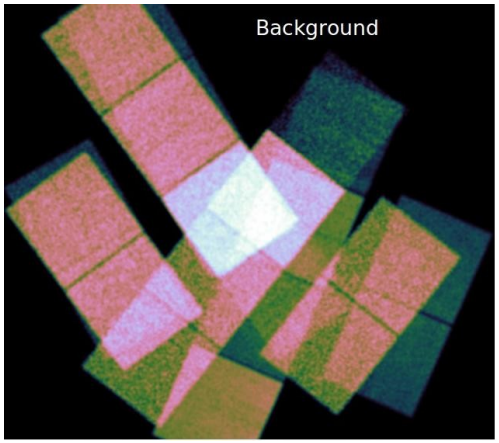
simulate_psf script – see later section of report

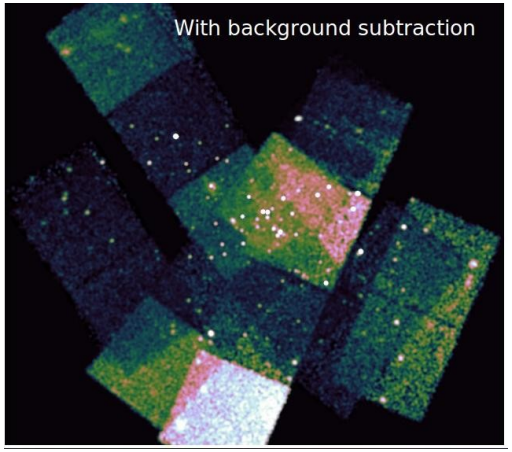
Scripts ready for release

Chandra X-ray Center

blanksky script – tailor blank sky background dataset to specific observation







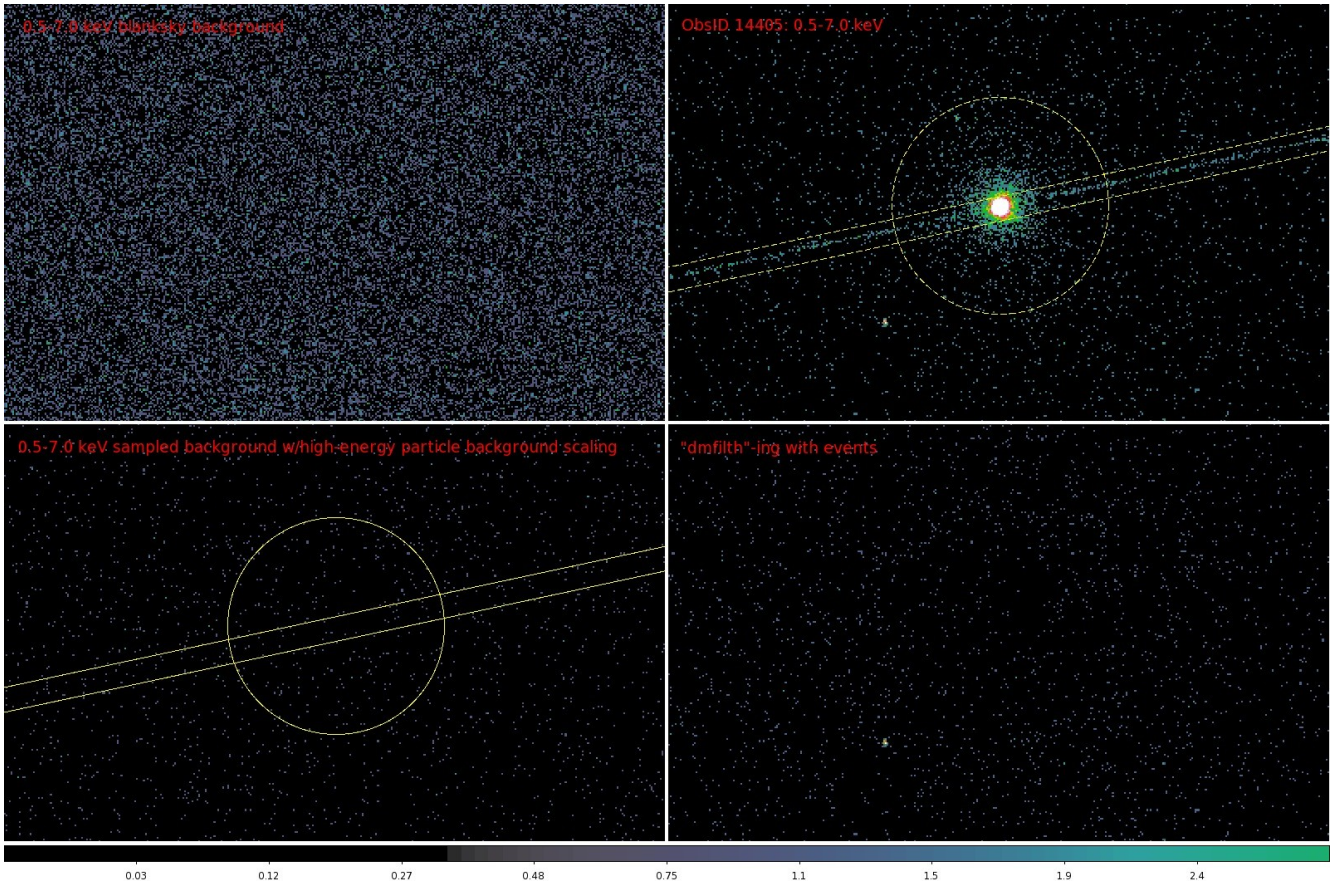
Example: Combined reprojected M101 counts data.
For each event file:
- find CALDB blank sky background for correct epoch
- scale background exposure time keywords so that scaled 9-12 keV particle-background-dominated count rates match the data
- reproject to correct roll angle and add correct RA, Dec coordinates

Result is a matched set of background event files which can be used for either image
background subtraction (as here) or event-based spectral subtraction.

blanksky_image companion script – create output image from above, matched to user image and its energy filter. Scales image pixel values correctly with 'backscal' values for each chip.

Scripts in development

blanksky_sample script



Event-based equivalent of the “fill in the hole” tool dmfilth
Other use case: add realistic noise to PSF simulation

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Sherpa

Sherpa 2016 Development

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- Sherpa 4.8.0 was released with CIAO on December 15, 2015 with the corresponding standalone release on January 13, 2016.
  - Infrastructure work to incorporate Travis continuous integration testing
    - standard testing environment for efficient and automatic testing
      - also important if accepting contributed code from users.
  - Bug fixes and limited new functionality in CIAO 4.8
    - Support for XSPEC12.9 models and bug fixes in model interface
    - New statistics 'wstat' - cstat with Poisson background; supporting catalog release

- The Sherpa code has been available on GitHub since April 2015.

https://github.com/sherpa/sherpa

- Easy build with "python setup.py install" into the users Python environment.
- Source code open for collaboration and users input
  - We had 4 contributors to the code from outside of the Sherpa team.
  - 12 external network members.

-Improved workflow between SDS scientists and DS team:
  - Direct code access, tests, changes, requirements and documentation;
  - Review the Issues and pull requests (code changes) at the biweekly meetings.

Sherpa GitHub Page

Sherpa GitHub Release Page

https://github.com/sherpa/sherpa/releases

Personal Open source Business Explore Pricing Blog Support This repository Search Sign in Sign up

sherpa / sherpa

Watch 12 Star 18 Fork 21

Code Issues 70 Pull requests 17 Projects 0 Wiki Pulse Graphs

Releases Tags

8 hours ago

4.8.2

9383484 zip tar.gz

Latest release

4.8.1

3799615

Sherpa 4.8.1

olaurino released this on Apr 15 · **157 commits** to master since this release

Sherpa 4.8.1

Sherpa 4.8.1 is the standalone counterpart to the 4.8.0 release, which was focused on supporting CIAO 4.8. In particular, this version introduces support for newer versions of the dependencies, along with some feature enhancements, bug fixes and additional, more accurate tests.

The newly supported dependencies:

- matplotlib v1.5
- numpy 1.10 and 1.11 (with and without mkl support)
- xspec v12.9.0i (when building from source)
- astropy v1.1.2
- region library v4.8 (from CIAO 4.8)

Please see the Caveats section for known issues regarding the XSpec support.

Mode details below (infrastructure changes are not shown):

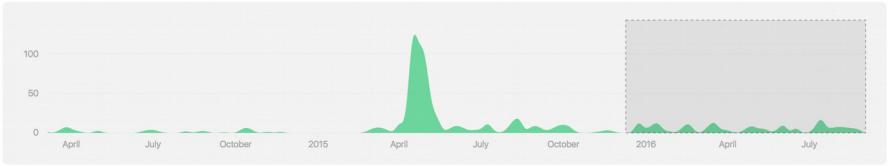
#102: fix issues when writing out FITS files using the `save_pha` and `save_table` commands when using the `astropy` / `pyfits` backend (bug #46). Fix for when the notice2d_id, notice2d_image, and the ignore version functions are called with an invalid identifier (i.e. an identifier that i snot an integer or string value). The error is now an ArgumentTypeErr with the message "'ids' must be an identifier or list of identifiers". It was a NameError with the message "global name '_argument_type_error' is not defined".

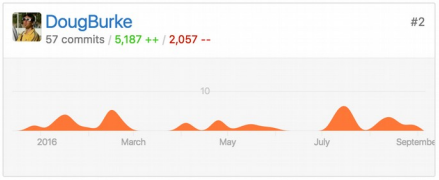
Activity summary and contributors:

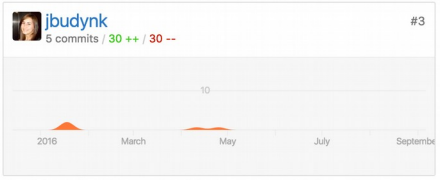
Dec 19, 2015 – Sep 11, 2016

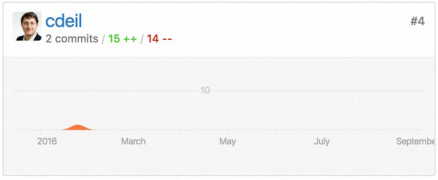
Contributions to master, excluding merge commits

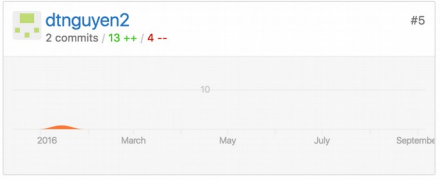
Contributions: Commits

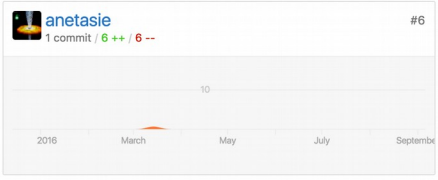


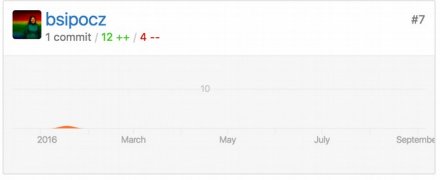










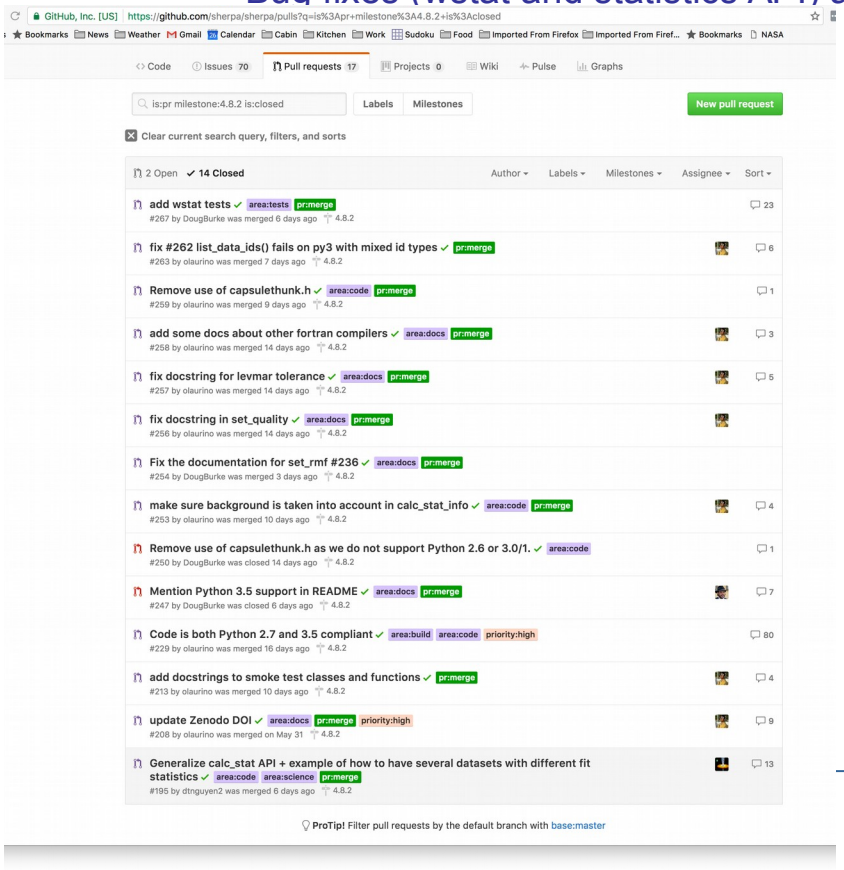


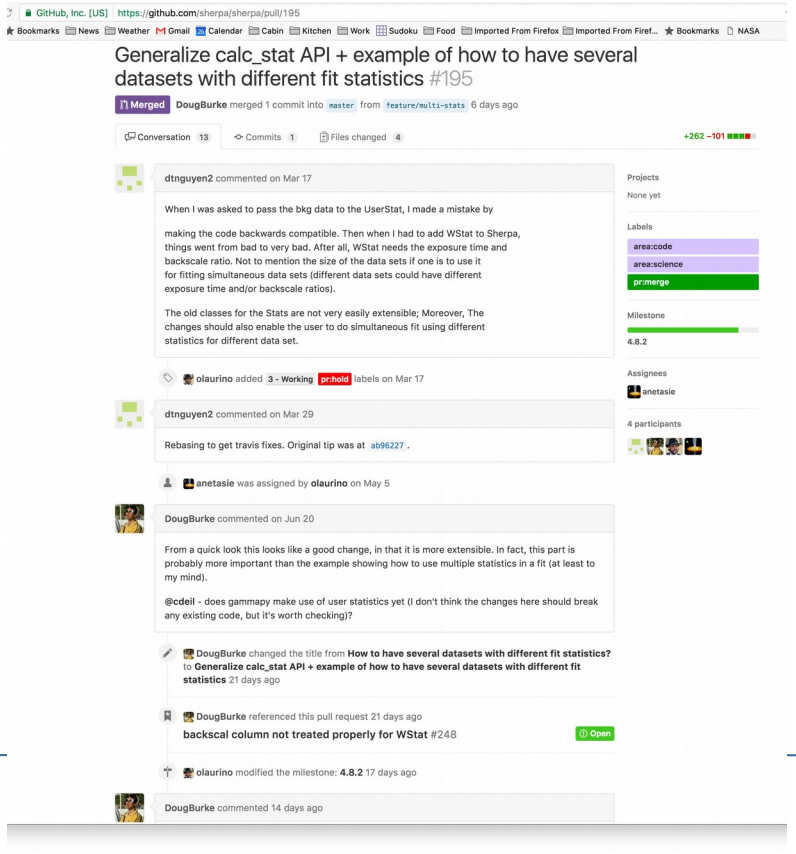
Sherpa 2016 Development

- Sherpa 4.8.1 standalone release on April 15, 2016
  - New version of dependencies, updates to the tests, bug fixes (save_all)

CIAO 4.9
December 2016

- Sherpa 4.8.2 standalone release on September 22, 2016
  - First release of the code with Python 3 (version 3.5) and standard Python 2.7
  - Bug fixes (wstat and statistics API) and ongoing review/documentation updates





Cumulative statistics (CUC request)

Chandra X-ray Center

"Does Sherpa include "cumulative statistics" (e.g. Anderson-Darling or KS-tests)? "

- We agree these would be desirable
- The scipy package scipy.stats includes them
- We'll take an action to document how to use them.

- Other relevant tests include Bayesian Information Criteria, Bayes Factors etc
- These are all things we'd like to have in Sherpa, but their development has been deferred due to pressure of other priorities
- We could invite external users (including the CUC) to contribute suitable code to Sherpa via github

Chandra X-ray Center

PSF

simulate_psf:

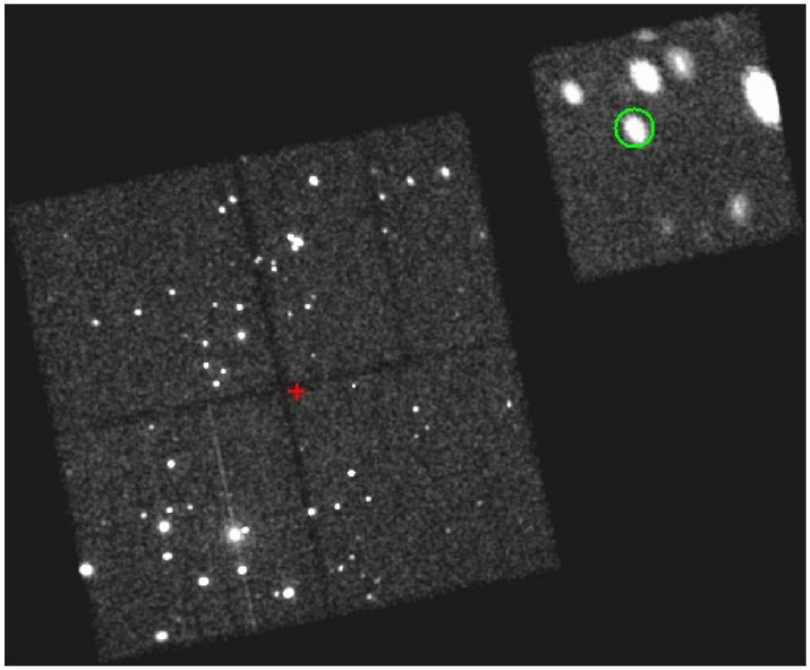
New script released

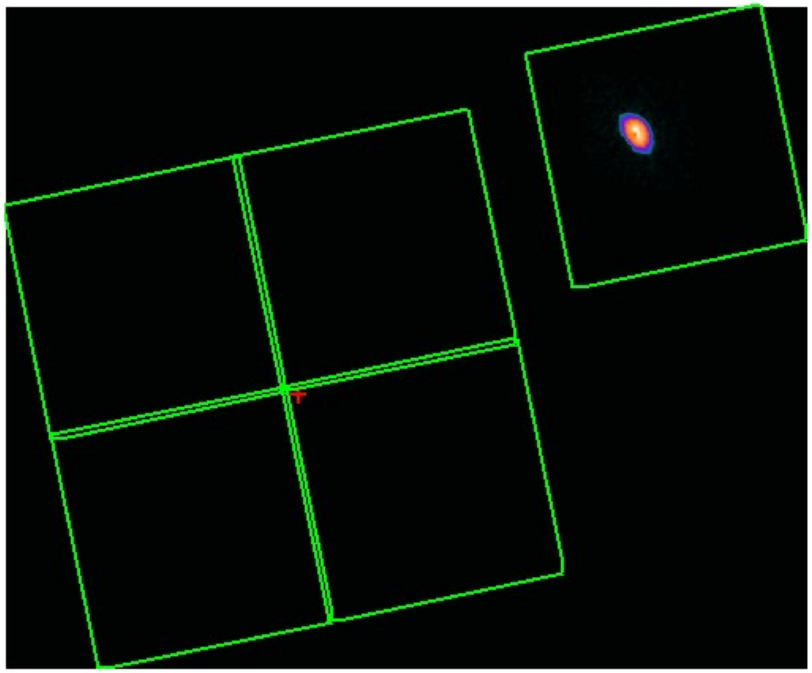
1) simplifies running of MARX for case of matching an existing observation
2) interface allows other simulators in future e.g. SAOTrace (currently not in portable distribution)
3) Runs multiple iterations, combines results into an image

Special cases:

- PSF on ACIS-S with aimpoint on ACIS-I, or vice versa
- Offset pointings, reprojected files
- Messy cases: multi-observation-interval Obsids, some subarray support

Example: OBS_ID 635, ACIS-01236





Red “+” indicates the aim point on ACIS-3 (aka ACIS-I)
To simulate the far off-axis PSF for the source circled on ACIS-6:

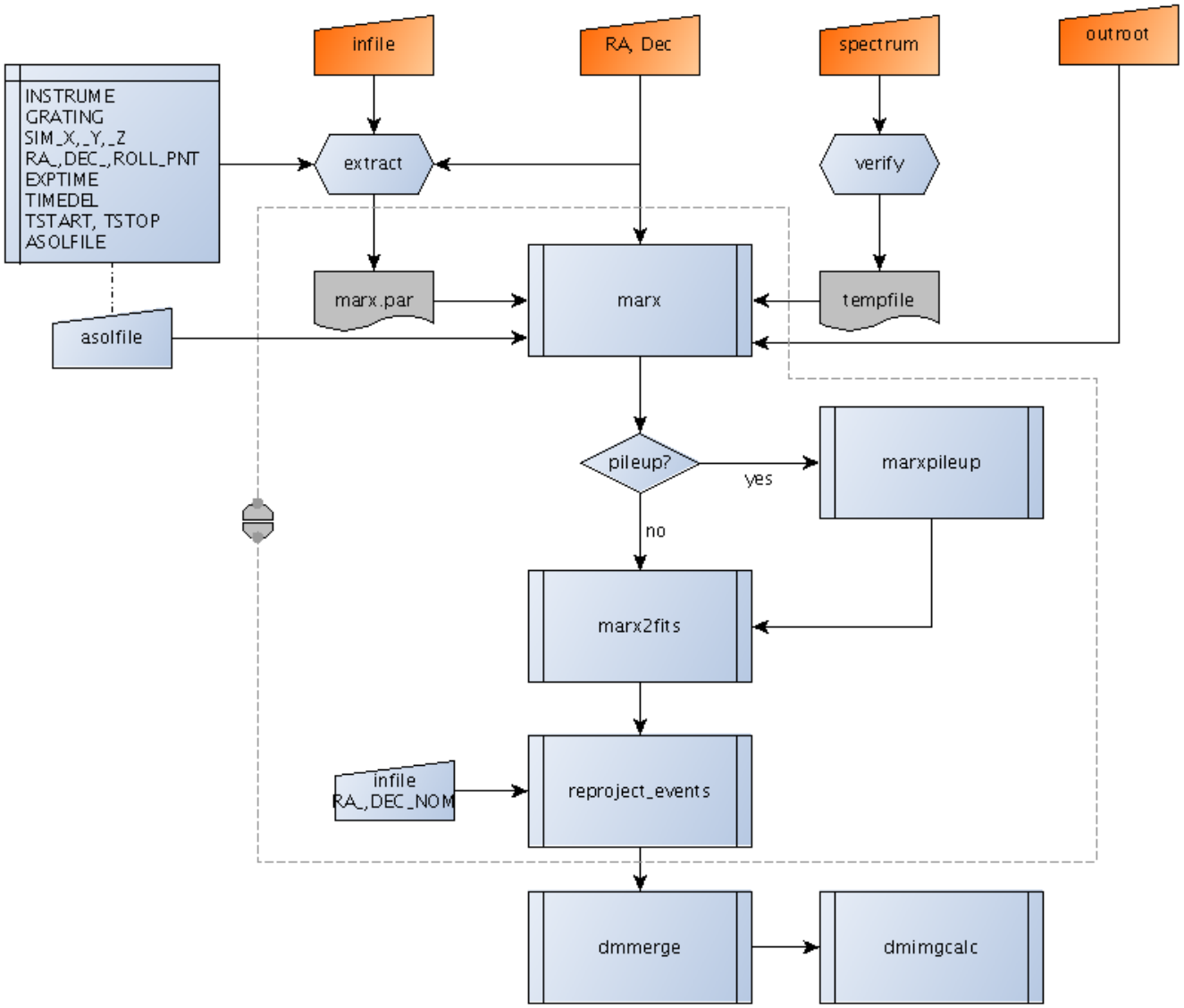
```
% simulate_psf acisf00635_repro_evt2fits ra=246.60014 dec=-24.413362 \
        monoenergy=3 flux=0.001 outroot=simpsf
```

This internally sets the appropriate MARX parameters

```
% pset marx DetectorType="ACIS-S"
% pset marx DetOffsetZ=-43.45491
```

which sets the DetectorType to include the CCD where the PSF will be detected and a large SIM_Z offset to get the aimpoint back to the ACIS-I configuration.

simulate_psf wraps complexity of marx thread




```
% simulate_psf acis_repro_evt2.fits outroot 246.88628 -24.556762 source_flux.dat
```

vs.

```
% cp $MARX_ROOT/share/marx/pfiles/marx.par marx.par
% chmod +w marx.par
% pset marx.par OutputDir=outroot
% pset marx.par SpectrumFile=source_flux.dat
% pset marx.par SourceRA=246.88628
% pset marx.par SourceDEC=-24.556762
% pset marx.par TStart=2000.28
% pset marx.par ExposureTime=103000
% pset marx.par GratingType=NONE
% pset marx.par DetectorType=ACIS-I
% pset marx.par SourceFlux=-1
% pset marx.par SpectrumType=FILE
% pset marx.par SourceType=POINT
% pset marx.par DitherModel=FILE
% pset marx.par DitherFile=pcad_asol1.fits
% pset marx.par RA_Nom=246.8247488
% pset marx.par Dec_Nom=-24.573379
% pset marx.par Roll_Nom=78.3
% pset marx.par ACIS_Exposure_Time=3.1
% pset marx.par ACIS_Frame_Transfer_Time=0.04104
% pset marx.par DetIdeal=yes
% pset marx.par DetExtendFlag=yes
% pset marx.par DetOffsetX=0.00144
% pset marx.par DetOffsetZ=0.005
% marx @@./marx.par
% marxpileup outroot
% marx2fits --pix-adj=EDSER outroot outroot.rays
% dmimgcalc "outroot.rays[bin x=lo:hi:bin,y=lo:hi:bin]" outroot.psf \
  op=imgout=((float)img1/img1_totcts)"
```

ChaRT 2

Chandra X-ray Center

ChaRT is a web interface to the CXC Optics group's mirror simulator: SAOTrace.

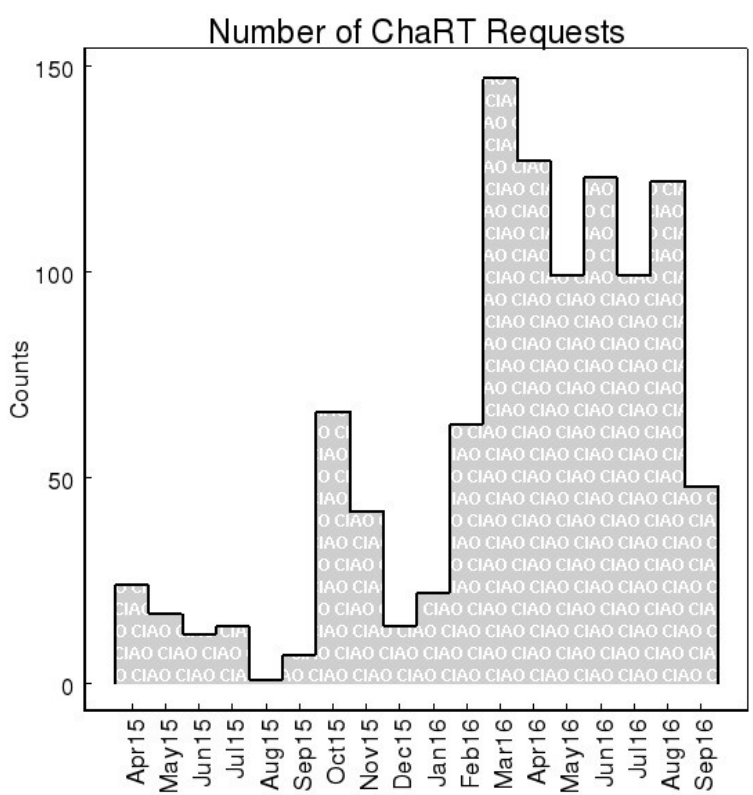
Phase 0: ChaRT was updated in 2014 to use the latest version of SAOTrace, v2.0.4, keeping the interface the same.

Phase 1: Allows users to supply aspect information enabling EDSER subpixel analysis when combined with MARX 5.

New interface released Sep 2015

Updates since then:

- increased logging
- clarify error messages
- prevent generating excessive (Tb) files
- updated to run CIAO 4.8, handle OS patches
- patch to work around wcs_update bug and compute quaternion values for user-supplied asol file


Number of ChaRT Requests
Counts
150
100
50
0
Apr15
May15
Jun15
Jul15
Aug15
Sep15
Oct15
Nov15
Dec15
Jan16
Feb16
Mar16
Apr16
May16
Jun16
Jul16
Aug16
Sep16

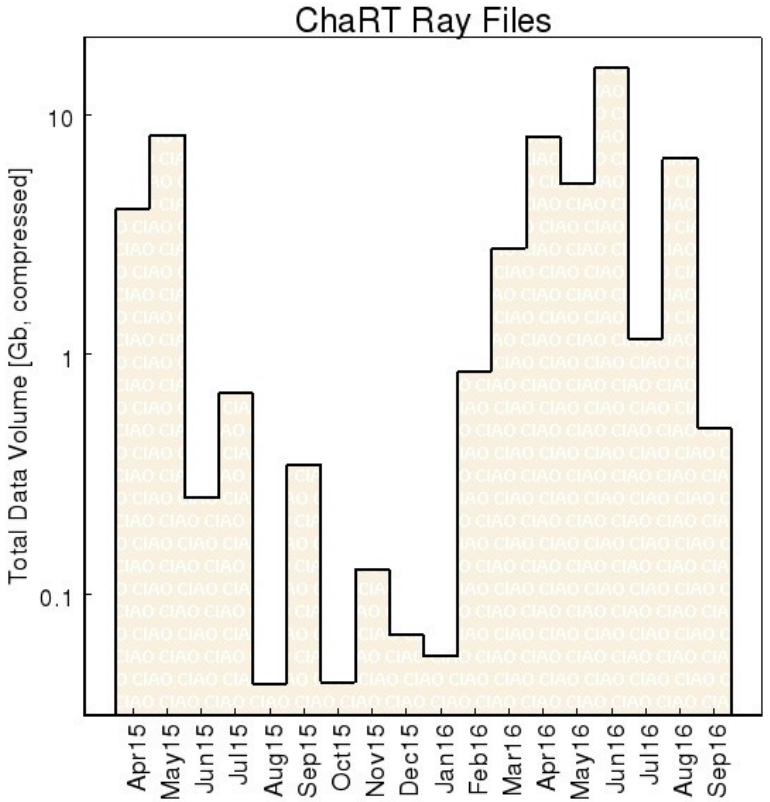


ChaRT Ray Files
Total Data Volume [Gb, compressed]
10
1
0.1
Apr15
May15
Jun15
Jul15
Aug15
Sep15
Oct15
Nov15
Dec15
Jan16
Feb16
Mar16
Apr16
May16
Jun16
Jul16
Aug16
Sep16

ChaRT 2 Interface

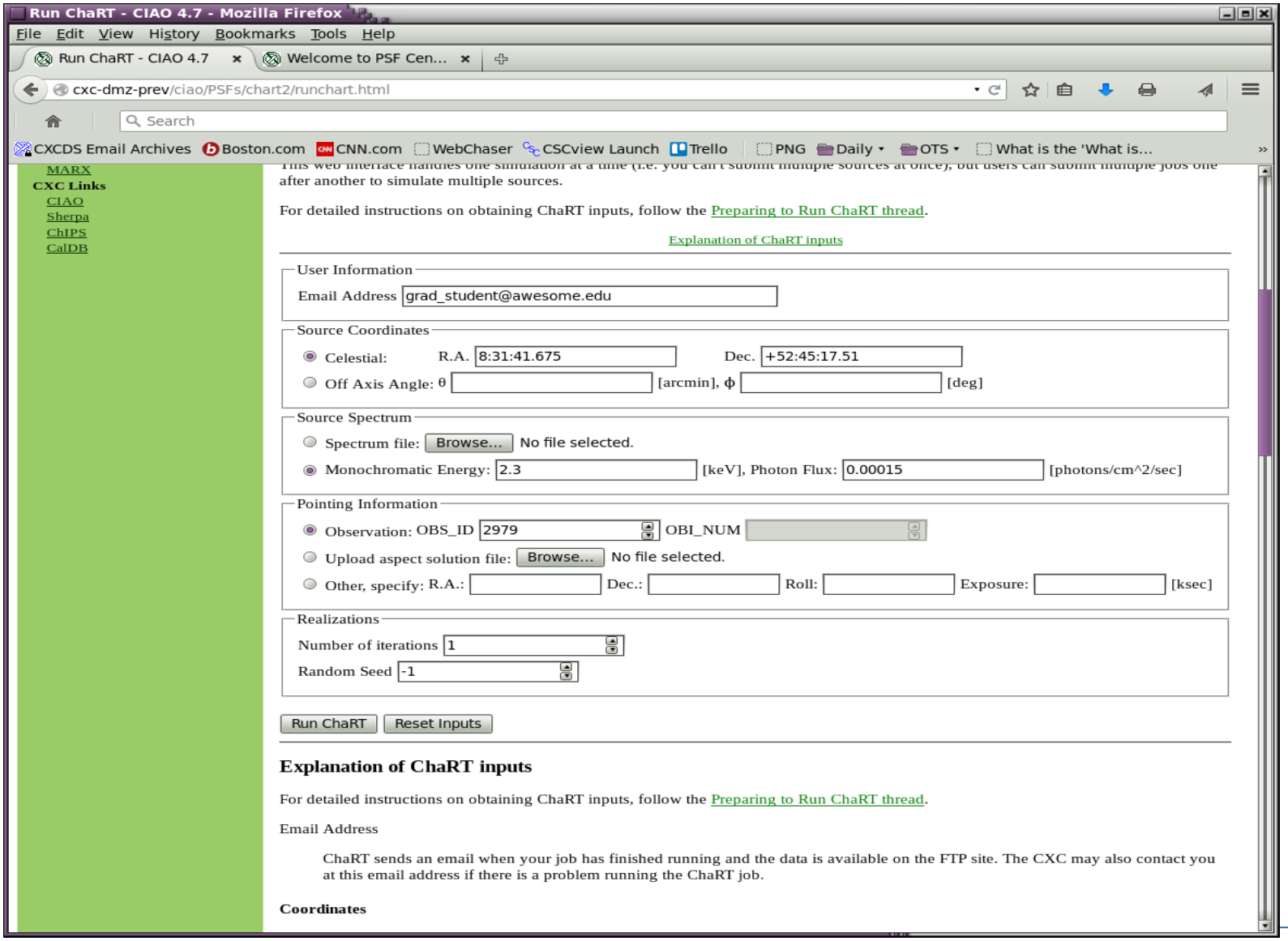
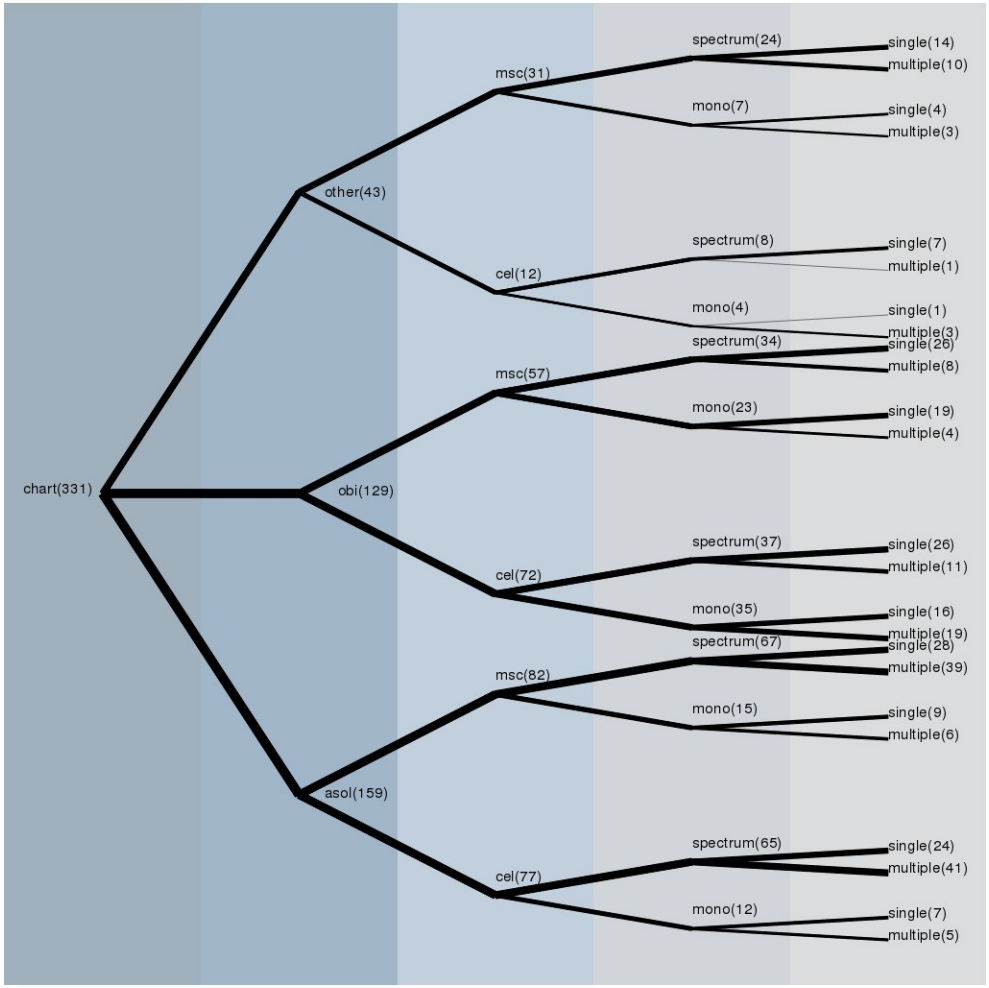


ChaRT 2 options



The ChaRT2 interface has a large number of possible parameter combinations leading to different code paths -

- Use of uploaded own aspect solution, autoretrieve using obsid, or specify observing conditions by hand
- Specify source RA,Dec or offaxis angle
- Provide spectrum or monochromatic energy
- Multiple or single iterations

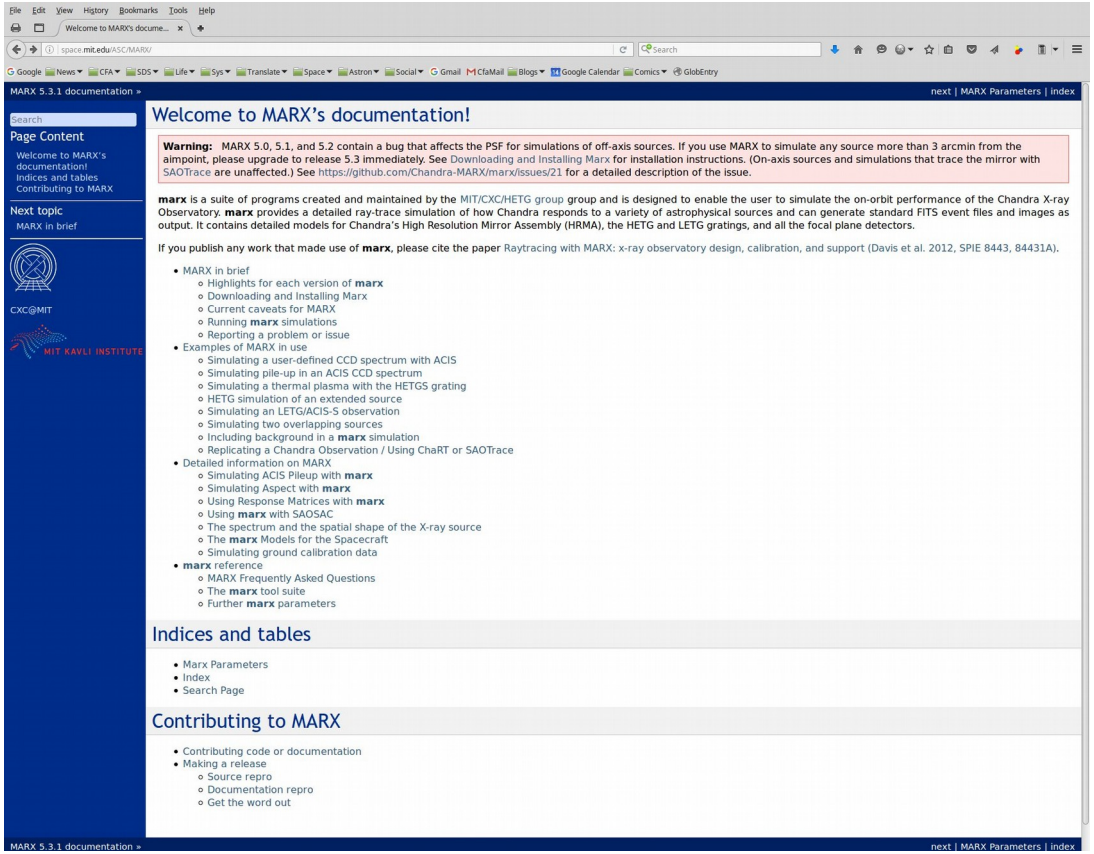
Analysis of actual use shows that all combinations of these options do in fact get used in practice with no one use case dominating.

MARX simulator

MARX: Updated documentation

MARX 5.2 release Dec 2015, maintenance and updated calibration

MARX 5.3 release Apr 2016, fixed bug introduced in 5.0 with off-axis simulations and introduced support for SIMPUT source description standard

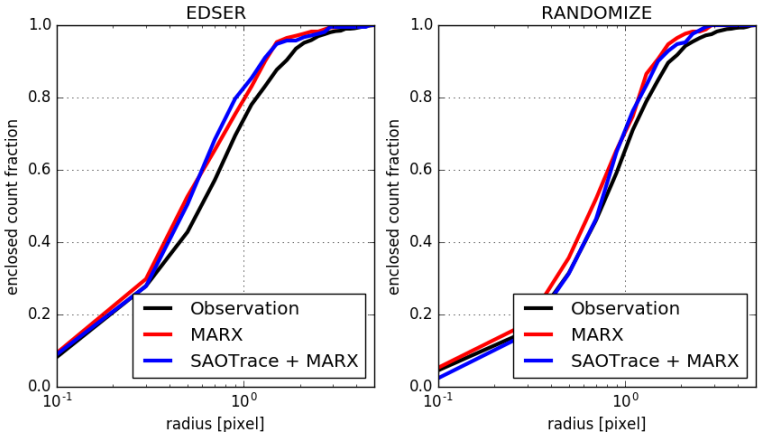


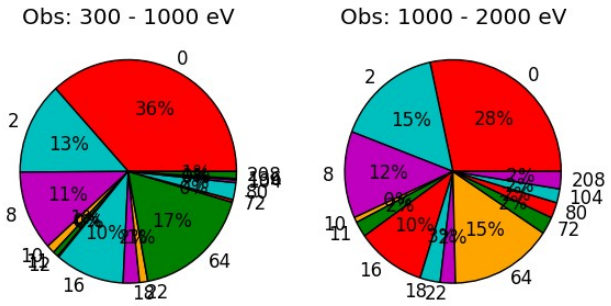
No simulation is perfect!

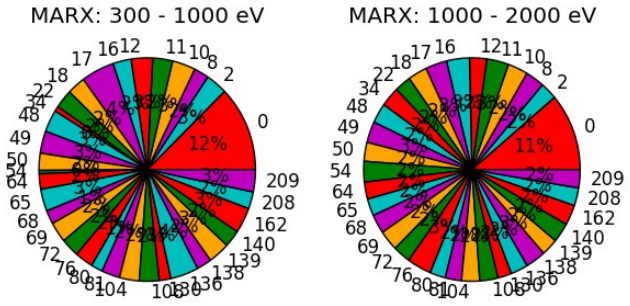
- Users are not always aware of the limitations.
- MARX was originally designed as HETG simulator, not as sub-pixel PSF tool.
- Reevaluated suitable values for 'aspect blur' parameter that match observations and added documentation to clarify use
- Creating suite of MARX fidelity tests by comparing observations, SAOTrace and MARX simulations.
- Plan: Ask CXC users, marx-users mailing list and you for feed back on tests now, then increase number of test cases and presentation based on that feedback.
- Highlight at next CfP

Currently implemented tests

- Point Spread Function (PSF)
  - On-axis PSF on an ACIS-BI chip
  - On-axis PSF on an ACIS-FI chip
  - On-axis PSF for an HRC-I observation
  - Off-axis PSF
  - On axis PSF at different energies
- Flight grade distribution
  - Grades on an ACIS-BI chip
  - Grades on an ACIS-FI chip

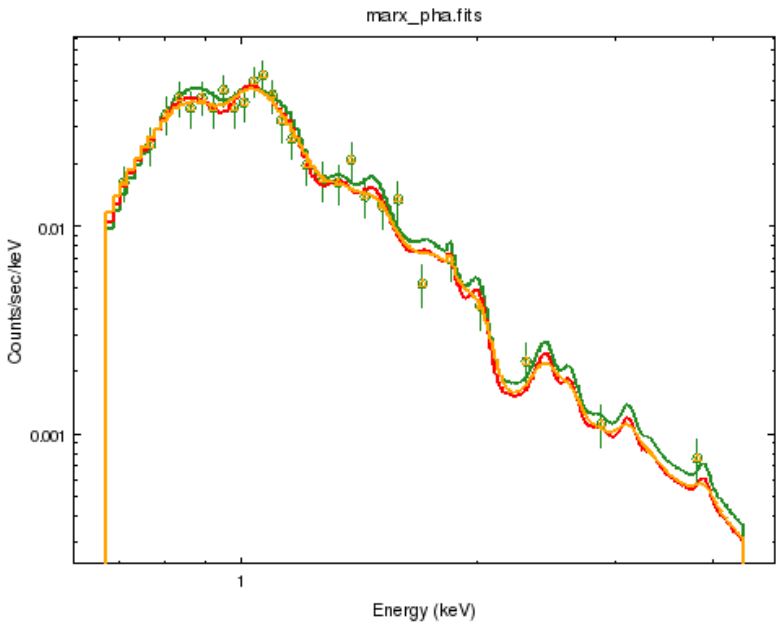


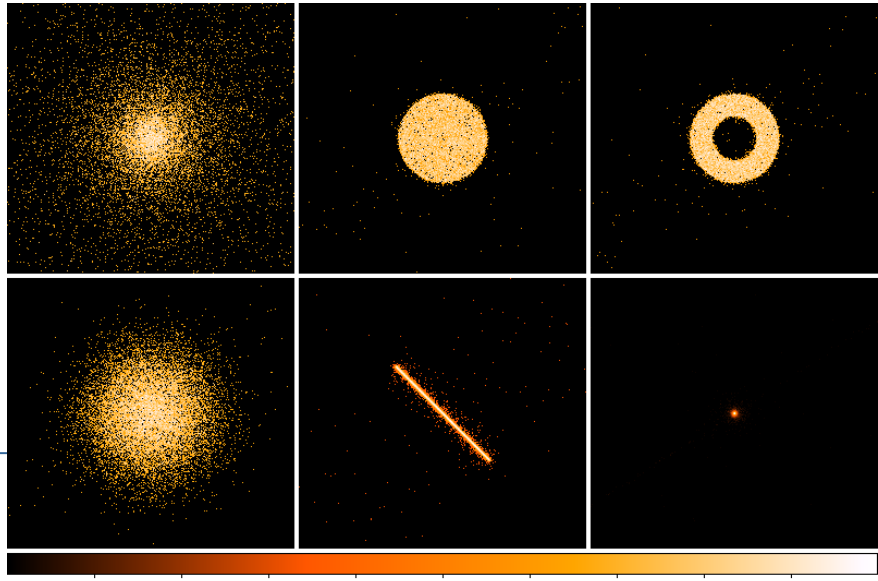




Currently implemented tests

- Reproducing an input spectrum
  - Absorbed powerlaw on ACIS-S
  - Two thermal components on ACIS-I
- Sources in marx
  - Build-in geometric sources
  - Image as source
  - Compiling a USER source
- Planned: positional accuracy, grating LSFs, ...

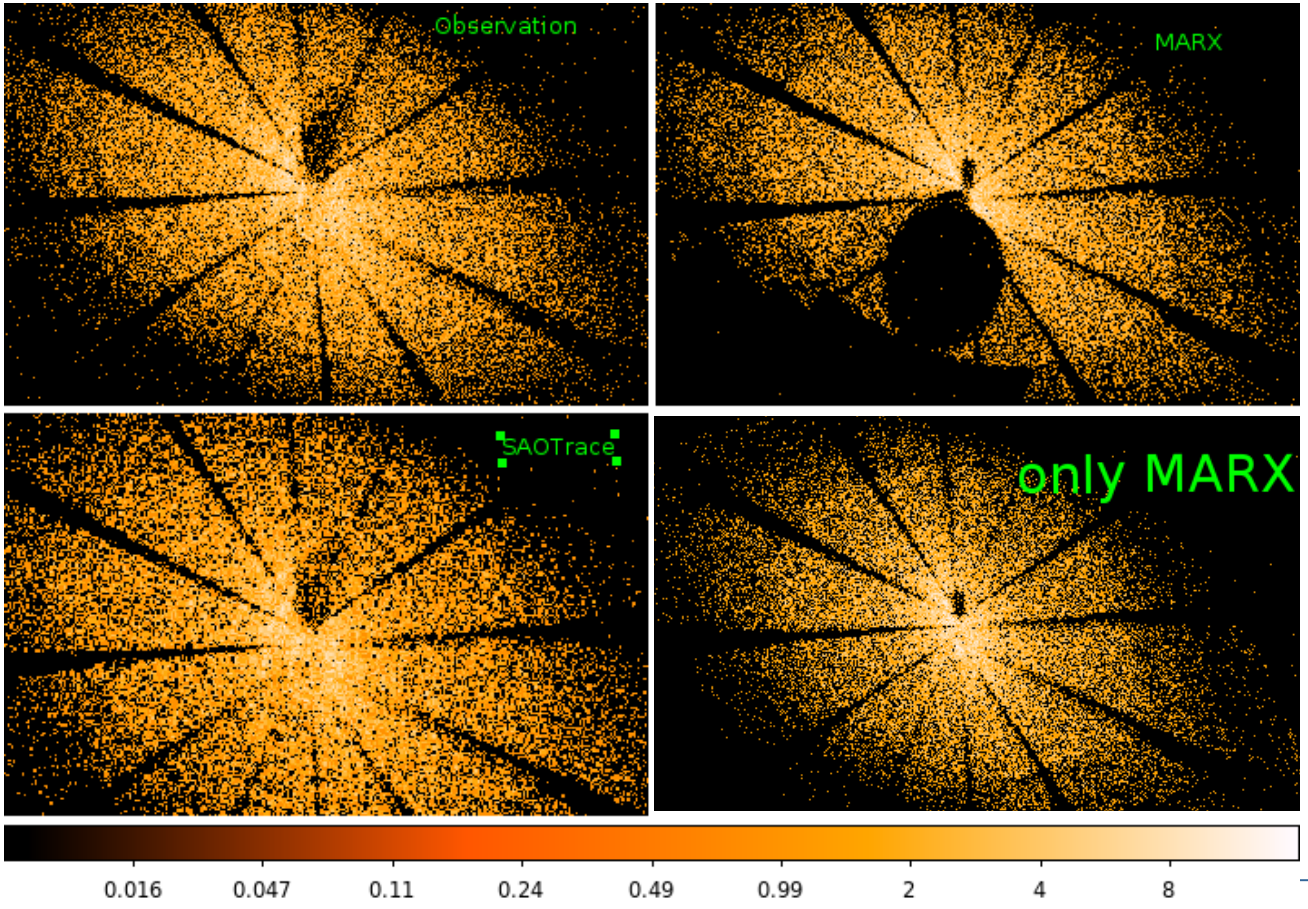




Suggestions welcome!

Example: Bug found in tests and fixed in Marx 5.3

Obs ID 1068



Marx 5.2

Marx 5.3

SAOTrace + MARX

Presentation: preview at http://space.mit.edu/cxc/marx-dev/tests

file:///melkor/d1/guenther/marx/doc/build/html/tests/PSF.html#on-axis-psf-on-an-acis-bi-chip

python multiprocessing

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Point Spread Function (PSF)

The point-spread function (PSF) for Chandra describes how the light from a point source is spread over a larger area on the detector. Several effects contribute to this, e.g. the uncertainty in the pointing, imperfections in the mirror (specifically for large off-axis angles) and the pixalization of data on detector read-out.

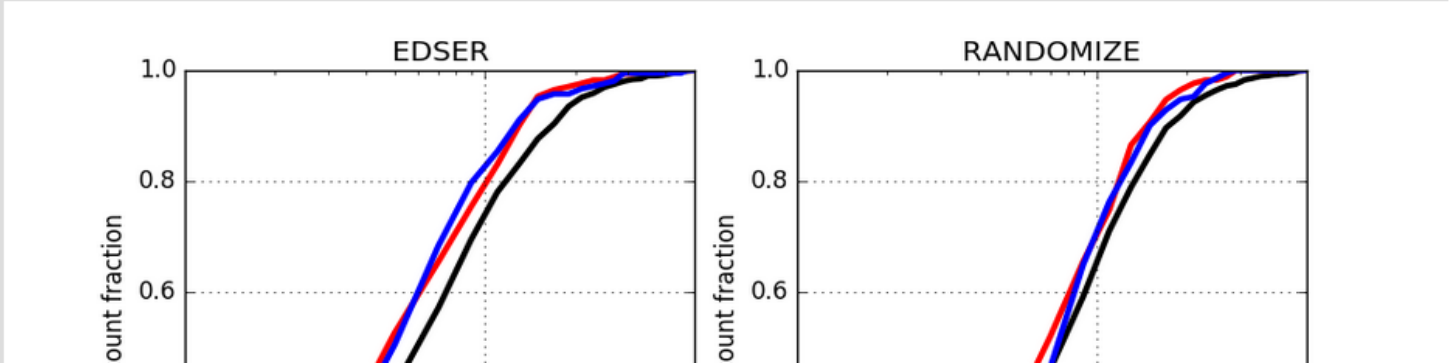
The following tests compare **marx** simulations, SAOTrace simulations, and data to look at different aspects of the Chandra PSF.

On-axis PSF on an ACIS-BI chip

data: ObsID 15713

code: On-axis PSF on an ACIS-BI chip

The PSF depends on many things, some of which are common to all observations like the shape of the mirror, and some are due to detector effects. For ACIS detectors, the sub-pixel event repositioning (EDSER) can improve the quality of an image, by repositioning events based on the event grade. This correction depends on the type pf chip (FI or BI). This test compares the simulation of a point source on a BI ACIS-S chip to an observation. The observed object is TYC 8241 2652 1, a young star, and was observed in 1/8 sub-array mode to reduce pile-up. The pile-up fraction in the data is about 5% in the brightest pixel.

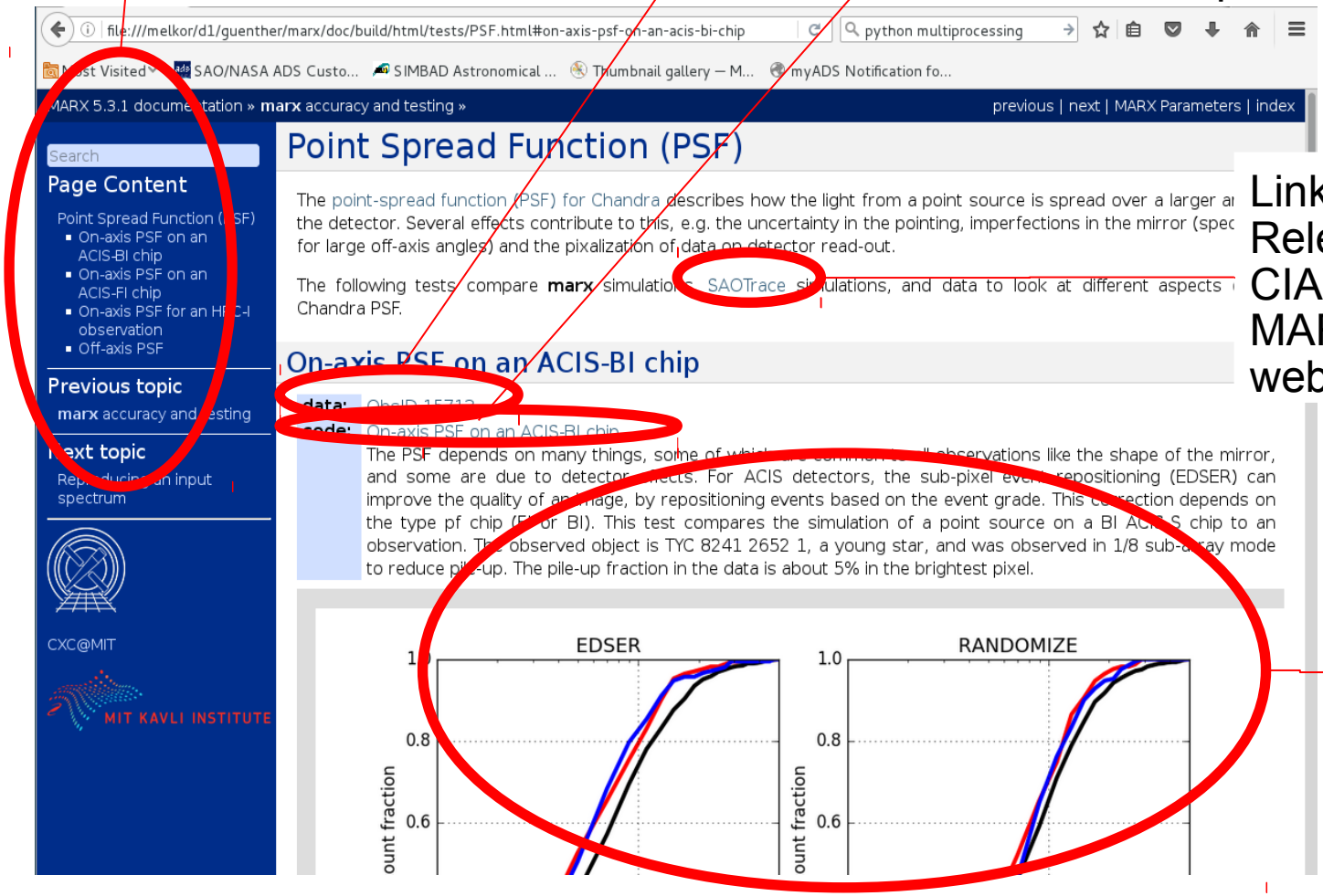


Presentation

Part of the MARX documentation website

Link to data in Obscat where data is used for comparison to MARX

Link to (lightly commented) code to serve as example



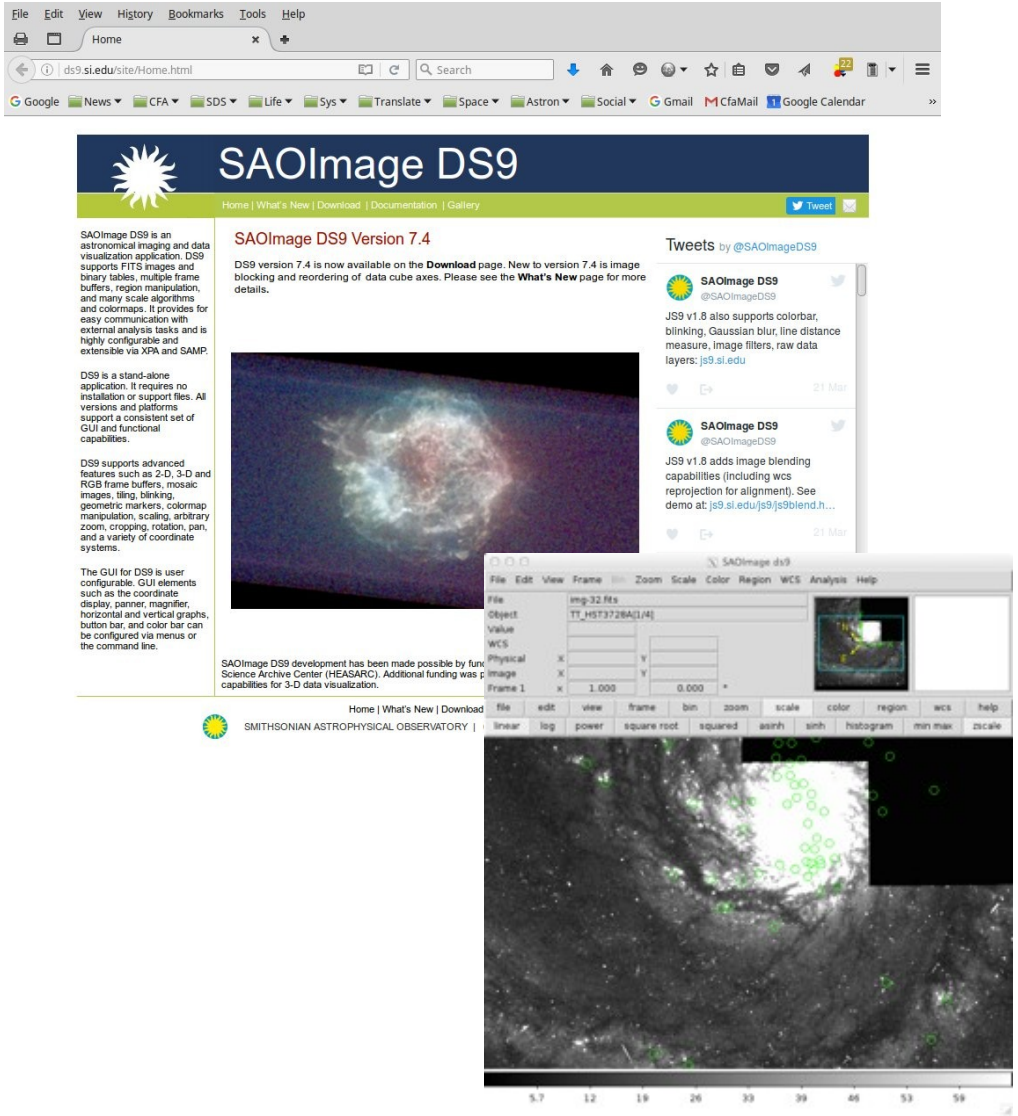
Links to Relevant CIAO / Sherpa MARX /... websites

Text and Images Illustrate results

Chandra X-ray Center

Visualization

SAOImage ds9



ds9 is an imaging program widely used in the astronomical community, well beyond X-ray astronomy. It was the successor to the earlier, also widely adopted, SAOImage program

ds9 is a key part of the Chandra data analysis infrastructure – it directly supports X-ray event files.

ds9 development/support since 1999 by Bill Joye on Chandra, HEASARC and grant funding. Bill recently reassigned to CXC-SDS to ensure tighter integration of ds9 with CIAO

This will allow improved coordination of ds9 releases with CIAO and emphasize the implementation of Chandra-specific ds9 bugfixes and enhancements.

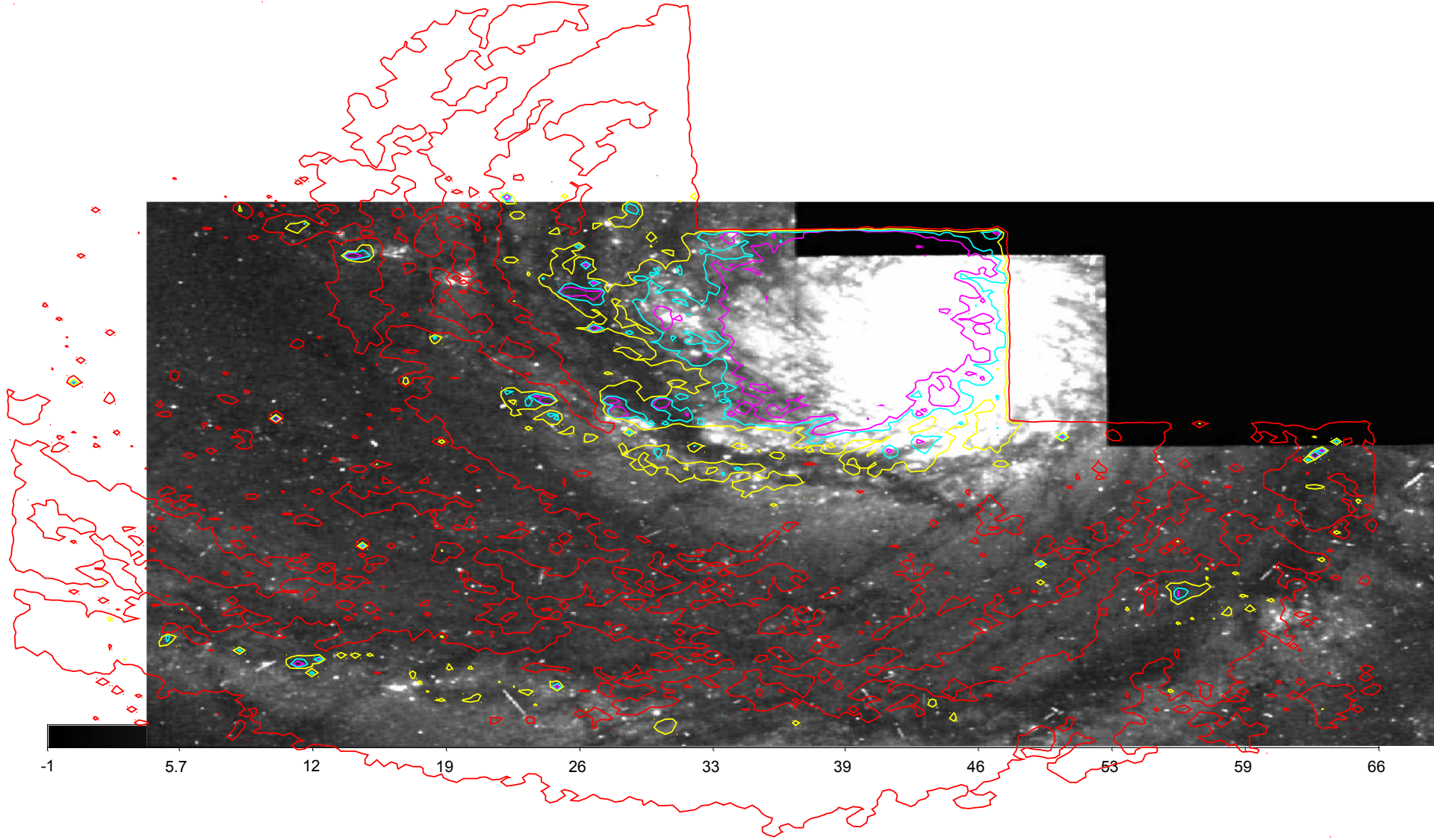
ds9 status

ds9 Version 7.5 – release to be coordinated with CIAO 4.9:

- Improved support for CIAO regions
- Preserves Chandra event file header keys in ds9 image header
- Improved loading speed for large data cubes
- Enhanced security for external (SAMP, XPA) access processes
- Milliarcsec precision in displayed coordinates
- New contour file format
- Improvements to use of preferences files across releases
- bug fixes
- Improving loading speed for large (>10 Gb) images
- Integrated release testing with CIAO

Ongoing development
- Implementing support for new FITS WCS spectral standards
- ds9 code base being transferred to Github
- Lower priority: Windows 10 support (educational/undergraduate demand)

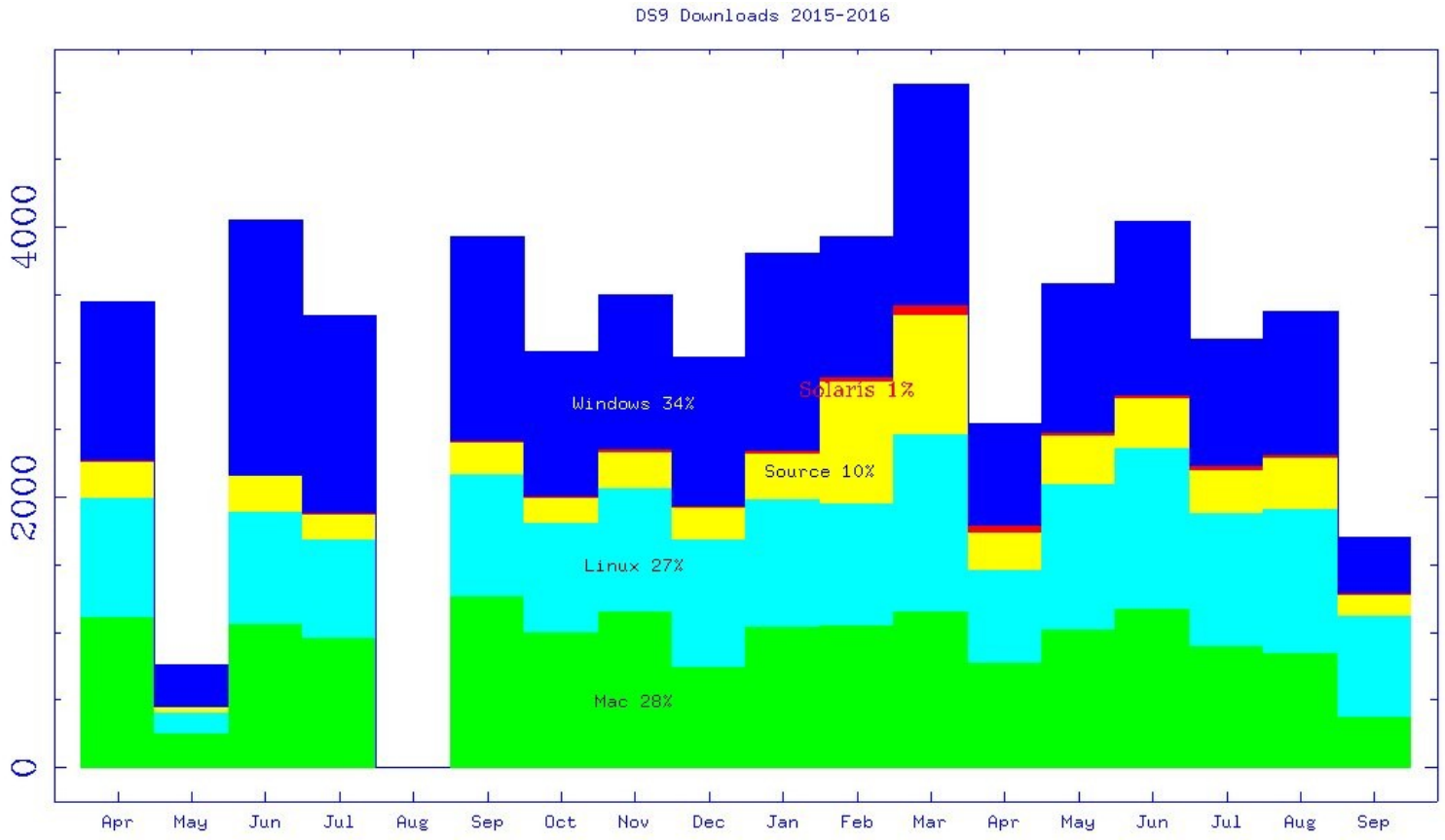
Helpdesk
- 106 help requests Jan 1 – Mar 31 (26 SAO, 80 external)



Contour save file support reimplemented with ability to control colors, properties of each contour; preserves contour level values

Format is like region file, with similar header

DS9 downloads Apr 2015- Sep 2016

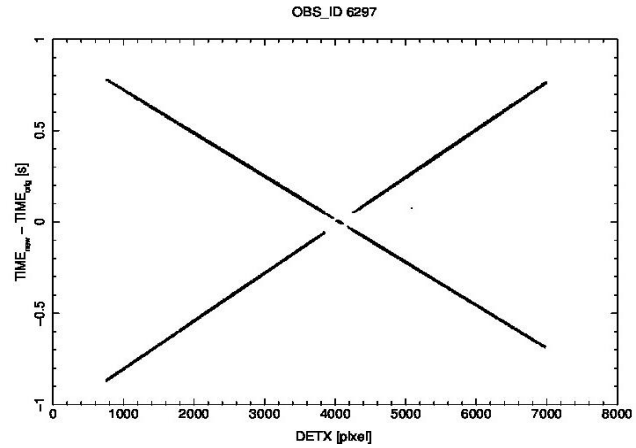


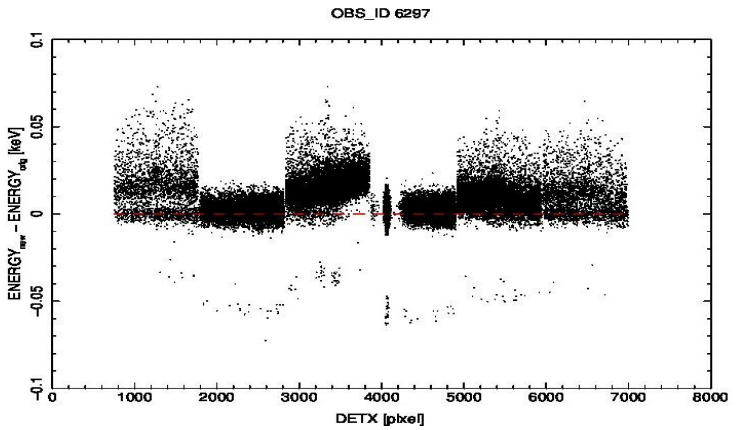
Some months have incomplete data
Total downloads in past year (Sep 2015 to Aug 2016) = 43057

Chandra X-ray Center

Gratings

CC mode (Recap: presented last year; now completed and in pipeline)

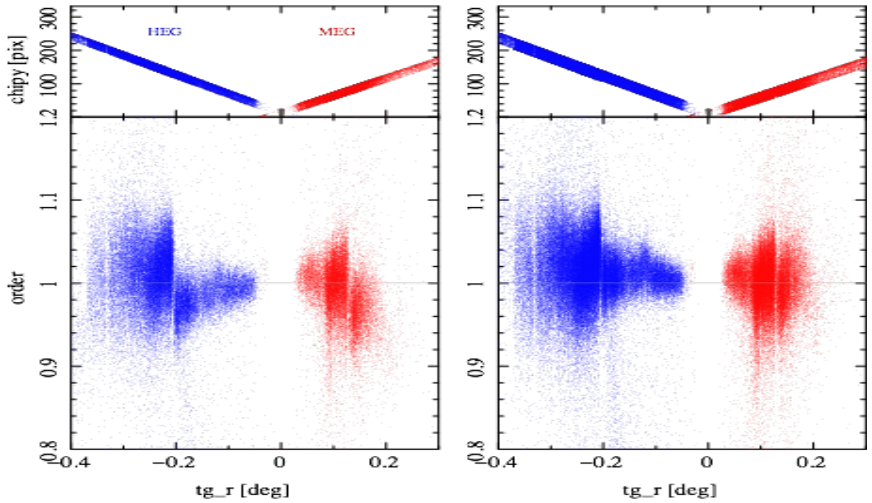




CC mode changes showing:

Left: Effect on photon arrival time vs X position – amplitude about 1 second

Right: Corrections to photon CCD energies (i.e. PI pulse heights) versus position – amplitude about 100 eV



Old analysis resulted in discontinuities in order vs. dispersion angle

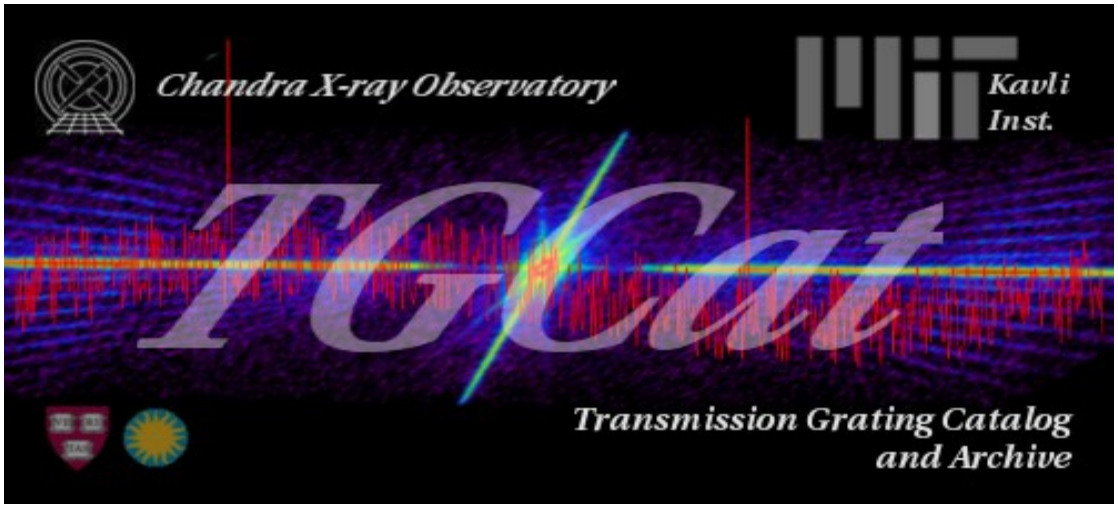
In new analysis, discontinuities are removed

pha_ro values found to be broken in 1999 data; problem now fixed

Improved:

- times
- energies
- CTI correction
- order sorting
- ~~Subpixel correction to CHIPY~~

Left: CIAO4.7 Right: CIAO4.8



TGCAT updates continue

- reprocessed using updated CC mode algorithms

- Improvements to user interface
- Planned further improvements: dynamic plotting, adjust zoom/binning/scale